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(19)

(54) IMPROVEMENTS IN OR RELATING TO COMMUNICATION SYSTEMS

(71) We THE PLESSEY COMPANY LIMITED, a British Company of 2/60 Vicarage Lane, Ilford, Essex, do hereby declare the invention, for which I/we pray that a patent may be granted to me/us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to so called 'store and forward' communication systems in which data is transmitted in the form of messages between "switching" nodes which are interconnected by links or link paths through which messages may be transmitted from node to node, and wherein the transmission of a message between nodes not directly connected to one another is via one or more intermediate nodes at which the message is briefly stored.

The nodes have only a finite capacity to store messages and the links have a finite carrying capacity. Consequently, if a link is fully loaded a message may have to be stored at an intermediate node while it waits for a space on such a link. In turn, this may cause the store at such intermediate node to become full so that other messages which are to be transmitted to such node cannot be received but continue to occupy storage capacity at the node from which they were to be transmitted. Thus, applied to the system as a whole, the time for which each message remains in the system is increased and the amount of carried traffic falls. This effect is known as congestion. One object of the present invention is to prevent congestion occurring or at least reduce the chance of its occurring rather than detecting congestion or its effects and then taking remedial action.

According to the present invention, a store and forward communication system comprises a plurality of nodes having data storage capability and links for the transmission of messages therebetween, the nodes being arranged to feed into the system messages at predetermined intervals determined in dependance upon the transmission time of previous messages through the system.

The transmission route through the system taken by a message passing from one node to another may include a number of intermediate nodes as well as a number of link paths. The transmission time for each link path is easily determined in accordance with its length and the mean transmission time taken to pass through each node can be determined by calculation or by simulation.

It is therefore possible after the acceptance of a predetermined number of messages from outside the system into a particular node without constraint to thereafter not accept another message at this node until it is estimated or established that a previously accepted message has arrived at its destination node and left the system.

By applying this technique to each node of the system the total number of messages transitting the system at any one time may also be limited and simulation has shown that by such limitation congestion may be obviated or significantly reduced.

The transmission time through links is substantially constant, whereas transmission time through nodes is to some extent variable and dependent upon factors such as the loading of the system and faults which may occur in the system. In many systems it is usual for a similar number of messages to be transmitted between a given pair of nodes in each direction and the transmission time in each direction is substantially the same. Taking account of the foregoing factors it is proposed that, data should be inserted into the message indicative of the delay at intermediate nodes so that when the message arrives at its ultimate destination it contains data from which the cumulative delay to which the message has been subjected can be computed. Since the transmission time of messages through the links is substantially constant the delay can easily be computed, whereby the interval between messages transmitted between a pair of nodes in one direction can be controlled in accordance with the

time taken for transmission of messages between the same pair of nodes in the other direction.

In order to avoid frequent and unnecessary adjustment of the interval between the transmission of messages it may be arranged that a certain degree of smoothing is utilised whereby the average transmission time for a particular number of messages is taken as the mean message time and the interval is calculated in accordance with the mean message time. It may also be arranged that for the purpose of calculating or arriving at the mean message time messages which take longer than a predetermined time may be ignored. An alternative to the foregoing method of adjusting the message transmission delay would be to arrange that at predetermined intervals control messages are injected by each node into the system to supply all destination nodes with timing information to control the interval between messages transmitted from these nodes.

If in accordance with the invention the rate at which messages are injected by each node into the system is controlled in accordance with the time a message takes to be transmitted through the system, optimum loading of the system may be achieved without causing congestion or 'locking up'.

WHAT WE CLAIM IS:-

1. A 'store and forward' communication system of the kind hereinbefore defined comprising a plurality of nodes having data storage capability and links for the transmission of messages, therebetween, the nodes being arranged to feed into the system messages at predetermined intervals, determined in dependance upon the transmission time of previous messages through the system.

2. A communication system as claimed in claim 1 wherein the system is initially arranged to receive a predetermined number of messages without constraint and thereafter to feed into the system the next and subsequent messages at the said predetermined intervals.

3. A communication system as claimed in claim 2 wherein data is inserted into messages transmitted into the system indicative of the delay incurred at nodes intermediate between message initiating nodes and destination nodes so that a destination node contains data from which the total transmission time between transmission from an initiating node and reception at the destination node is computed for the purpose of determining said predetermined interval.

4. A data transmission system as claimed in claim 7 wherein a node upon receiving a message transmits an acknowledgement to the node from which the message was transmitted.

5. A communication system substantially as hereinbefore described.

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